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POWER/VAC[®] Metalclad Switchgear

**The most significant new
metalclad design in 40 years.**

General Electric metalclad switchgear has long been the standard of excellence for medium-voltage power circuit protection and control. Since the introduction of the first vertical lift metalclad switchgear design in 1928, General Electric has led the industry in making technological improvements to assure the highest quality product to meet customer needs.

Consistent with its dedication to continually improve switchgear quality and performance, General Electric has introduced POWER/VAC[®] vacuum metalclad switchgear, the most significant new metalclad design in 40 years. It represents a marriage of General Electric's proven vacuum interruption technology and its years of experience in the design, production and application of medium-voltage switchgear.

**By
design,
there is
no
equal**

®Registered trademark of General Electric Company.



The complete POWER/VAC Metalclad Switchgear line is being introduced on a planned schedule through June 1977, beginning with the availability of the 4.16 kV-250 MVA and 13.8 kV-500 MVA ratings in September 1976. Thus, not all ratings listed herein were immediately available at the time of printing of this publication (August 1976). Announcements will be made as each new rating becomes available. Contact your General Electric sales engineer for availability of specific ratings during the introduction period.

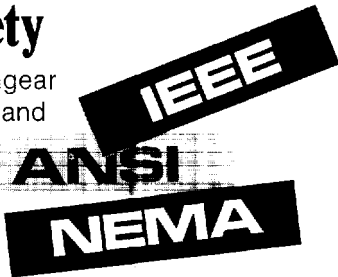
General Electric POWER/VAC metalclad switchgear provides the time-honored advantages of metalclad switchgear—safety, flexibility, quality and economy—*plus* the benefits of GE vacuum interruption—reliability, simplicity, less maintenance and reduced size and weight. These benefits have been blended into a metalclad design that:

- offers two-tier breaker stacking for added application freedom and significant floor space savings
- incorporates standardized modular construction to simplify station planning and provide installation economies
- features pre-engineered protection, instrumentation and control packages for the majority of applications.

By design, there is no equal to General Electric's POWER/VAC metalclad switchgear. Its many new features minimize engineering time while providing effective circuit protection based on established engineering practice and the use of high-quality devices.

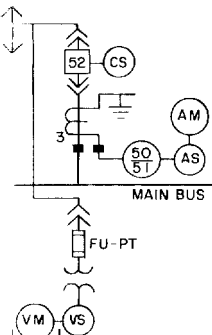
Metalclad safety

GE POWER/VAC switchgear is designed, assembled and tested to applicable ANSI, IEEE and NEMA standards. It incorporates full compartmentation with primary functions segregated by grounded metal barriers. No live parts are exposed and safety interlocks are provided throughout. These features plus totally-enclosed arc interruption in vacuum provide a new standard of value for safety.



Metalclad flexibility

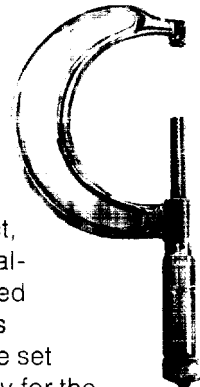
GE POWER/VAC switchgear has been designed to meet a wide variety of protection and switching applications. These include radial, main and transfer, and feeder tie. All functional units such as incoming line, feeder, bus-tie, bus-entrance and auxiliary units are



available, assuring your system planning engineer complete application flexibility. These basic functions plus the versatility of two-tier breaker stacking add up to a new standard of value in application.

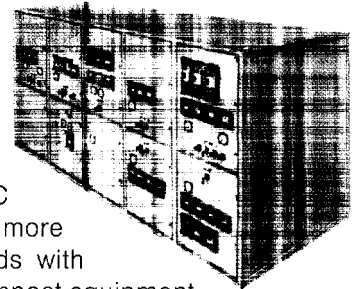
Metalclad quality

Modular design of GE metalclad switchgear coupled with highly-tooled parts and standardized production techniques offers dual benefits: maximum product flexibility plus high quality. In fact, General Electric's wealth of metalclad experience plus the improved design and producibility features of POWER/VAC switchgear have set the pace for a new level of quality for the decades ahead.



Metalclad economy

Factory assembled metalclad switchgear equipment has, historically, provided attractive installation, maintenance and performance economies. POWER/VAC switchgear does this and more by meeting system needs with smaller, lighter, more compact equipment.



Switchgear...PLUS!

POWER/VAC is metalclad but with an extra measure of value in safety, flexibility, quality and economy. In total, it makes POWER/VAC the new standard of excellence in metalclad switchgear.

These superior design features are standard with GE POWER/VAC switchgear.

Unique two-tier construction adds application flexibility and can provide substantial floor-space savings for most installations. Breaker and auxiliary units can be mixed, top and bottom; and, depending on rating, breakers can be stacked two-high. In addition, a single, basic unit size is used for all switchgear ratings, functions and circuit configurations—a valuable asset in planning and layout of your switchgear requirements.

In switchgear equipment, safety and reliability go hand in hand. Complete compartmentation of primary functions in GE's simplified POWER/VAC switchgear design enhances operator safety while increasing reliability.

Compartmentation barriers isolate each unit from adjacent units. Within each unit, the breaker, bus, cables, control and potential transformers and panel devices are isolated by metal barriers. These barriers, basic to metalclad switchgear, increase operator safety by preventing inadvertent access to energized parts and improve reliability by confining fault damage, thus reducing outage time.

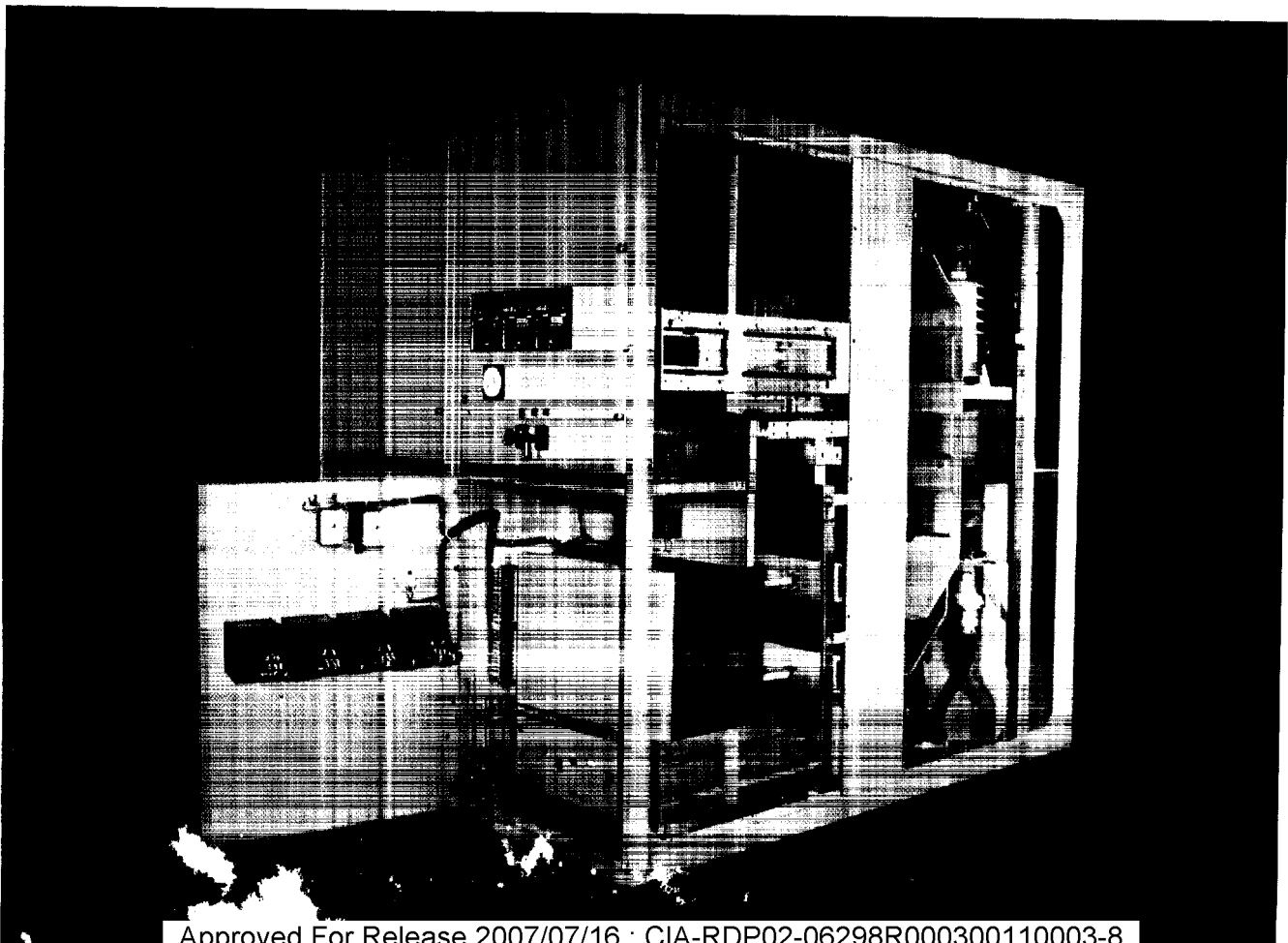
General Electric POWER/VAC switchgear begins with a rugged steel frame. All right-angle joints are

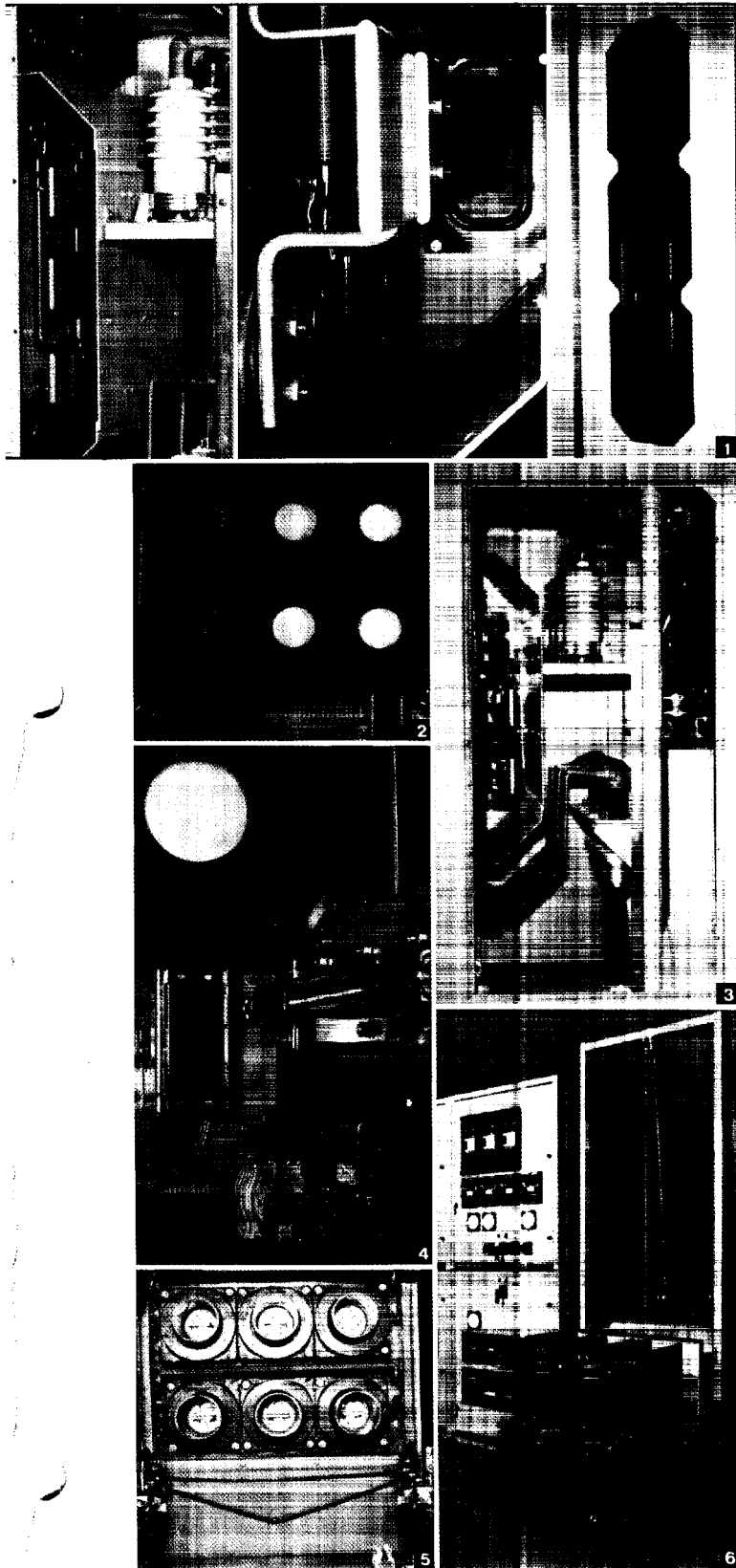
reinforced with steel gussets for added strength and dimensional integrity. Metal barriers provide the necessary compartmentation of major functions. In addition, a thoroughly tested insulation system utilizes carefully selected, coordinated and quality controlled materials. All these features help make long term reliability a reality.

Relays and instrumentation are effectively compartmentalized by the breaker front panel. Open doors are securely held with positive stops so breakers can be inserted and withdrawn without damaging control, indication and protection devices.

Breakers move into position on side rails. Positive stops are provided in the test/disconnected and connected positions. Movement to the connected position is accomplished with a simple, rugged jackscrew racking mechanism which can be manually or electrically operated from the front of the unit with the door closed.

A simple portable lifting device facilitates handling of the lightweight breaker element when placing it in the compartment or removing it for maintenance or inspection.





1. Main bus compartment is completely isolated by metal and track-resistant polyester barriers. These rugged, molded polyester barriers also serve as high-strength bus supports. Bus bars are insulated with high dielectric, thermosetting epoxy insulation, applied using the fluidized-bed process. All bus bar joints have silver-to-silver connections for positive contact and low resistance, and are insulated with vinyl boots. Porcelain insulation to ground is provided as standard in the 15 kV class equipment.

2. Grounded metal safety shutters, located behind a polyester glass shutter barrier, isolate the primary disconnects as the breaker is moved from the connected position. The shutters are positive-actuated and prevent accidental contact with the energized primary disconnects when the breaker is removed.

3. Cable compartment in a basic two-breaker vertical section has ample space for termination of two 750 MCM cables per phase, including stress-cone makeup, or pothead installation. Standard extension compartments can be added for additional space, if required. Of course, the entire cable area space is available for use when only one breaker is supplied in a vertical section.

In double-breaker equipments a vertical steel duct serves as a pull-box and barrier for the rear-most set of cables. This duct is easily removed to facilitate initial installation, but is designed to be left in place in most situations requiring access to the "inside" terminations.

NEMA drilling is provided at all cable connection points. No terminals are supplied as part of a basic unit but a wide variety of optional terminals, pot-heads and other terminations are available.

4. Secondary disconnects combine the positive-contact reliability of a plug with the automatic, self-aligning convenience of sliding-type contacts. The movable plug remains engaged between the connected and test/disconnected positions, then is easily disengaged by a simple linkage operable from the front of the circuit breaker.

5. Current transformers are safely isolated behind the shutter barrier. Two CT's per phase can be accommodated on both the line and load sides of the breaker. CT's are front-accessible after removal of the shutter barrier.

6. Breaker lifting is accomplished using a portable lifting device. The portable lift doubles as a transfer truck to transport the breaker and is suitable for use on indoor or outdoor installations.

New breakers are smaller, safer to operate than conventional units.

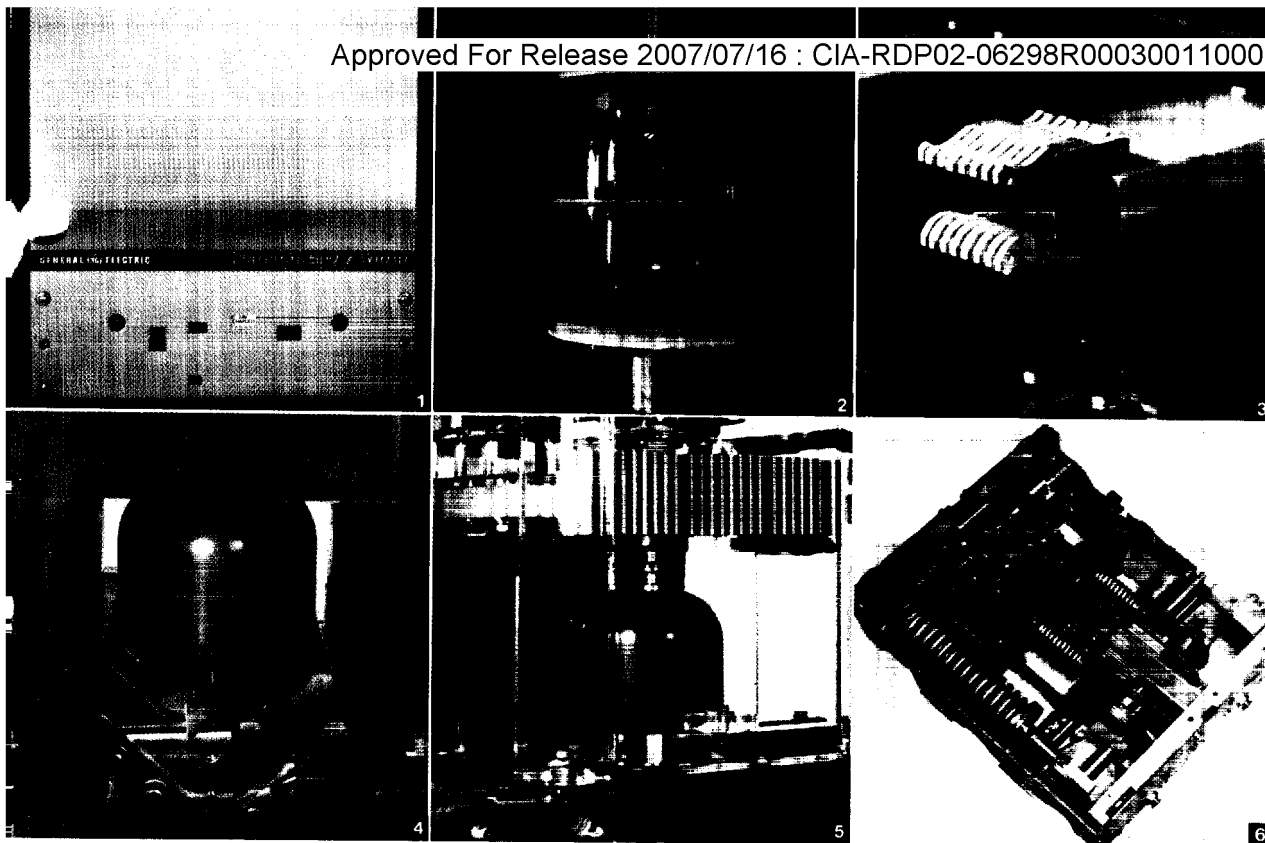
The new vacuum breaker developed for POWER/VAC switchgear is a high-performance, compact device. Only 33 inches high, 30 inches wide and 28 inches deep, the breaker is significantly smaller than conventional medium-voltage drawout circuit breakers. And not only is it small, but it's lightweight, too. Breaker weights range from 550 to 780 pounds depending on continuous current rating. Designed and thoroughly tested to applicable ANSI, IEEE and NEMA standards, the POWER/VAC breaker sets an advanced design benchmark for the switchgear industry.

A new measure of standardization has been achieved with POWER/VAC breakers. All breakers, regardless of voltage or interrupting capability, are the same size. Not only that, most parts of the frame, primary conductors and disconnects, mechanism and interrupter assemblies are identical throughout the breaker product line. This new level of standardization means a higher quality product through high-volume parts production with fewer parts to stock. Training time for operating and maintenance personnel is also reduced, as is repair time.

Fully tested to industry standards, the new circuit breaker utilizes General Electric vacuum interrupters for fast, reliable and safe interruption. Consistent quality is insured through precision tooling and through quality control. Interrupting contacts are sealed in a high vacuum environment and require no maintenance, eliminating problems caused by lack of contact maintenance or improper reassembly and alignment often experienced with conventional circuit breakers.

Though it's small in size, the new POWER/VAC breaker is big on safety. A complete system of mechanical and electrical safety interlocks is provided. For example, breaker contacts must be open before the breaker can be moved to or from the connected position. A positive mechanical stop is provided when the breaker reaches the connect or test/disconnect positions. Mechanical interference interlocks are provided to permit only breakers with the same or higher ratings to be inserted in any specific compartment. These and other required interlocks, combined with appropriate indicators, provide a complete safety interlock system, designed and built to prevent unsafe operation.





1. Front Panel. This attractive, 11-gage steel front panel fits into a collar in the equipment when the breaker is in the connected position. It provides a metal barrier between the breaker compartment and the secondary device compartment. Operating controls and indicators are well marked and easy to read. The front panel contains: TRIP button; CLOSE button; OPEN/CLOSE indicator; CHARGE/DISCHARGE indicator; operations counter; and has integral handgrips to facilitate moving the breaker.

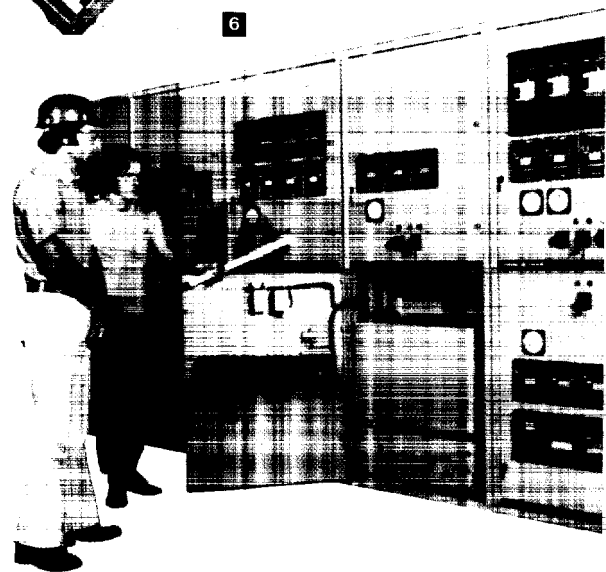
2. Vacuum Interrupter. The heart of General Electric's POWER/VAC switchgear is the vacuum interrupter. For safe, reliable and consistent current switching and interruption, there is no equal. During interruption the arc is completely sealed; hence, no arcing by-products are expelled to the environment. Main contacts are sealed in a vacuum—completely protected from dust, pollutants and humidity—and require no contact maintenance.

3. Primary Disconnect. The primary disconnect finger set is rugged and simple. Designed for optimum contact, built of silver-plated copper, and tested for continuous and momentary currents, these discon-

nects insure proper contact for the critical primary disconnect function.

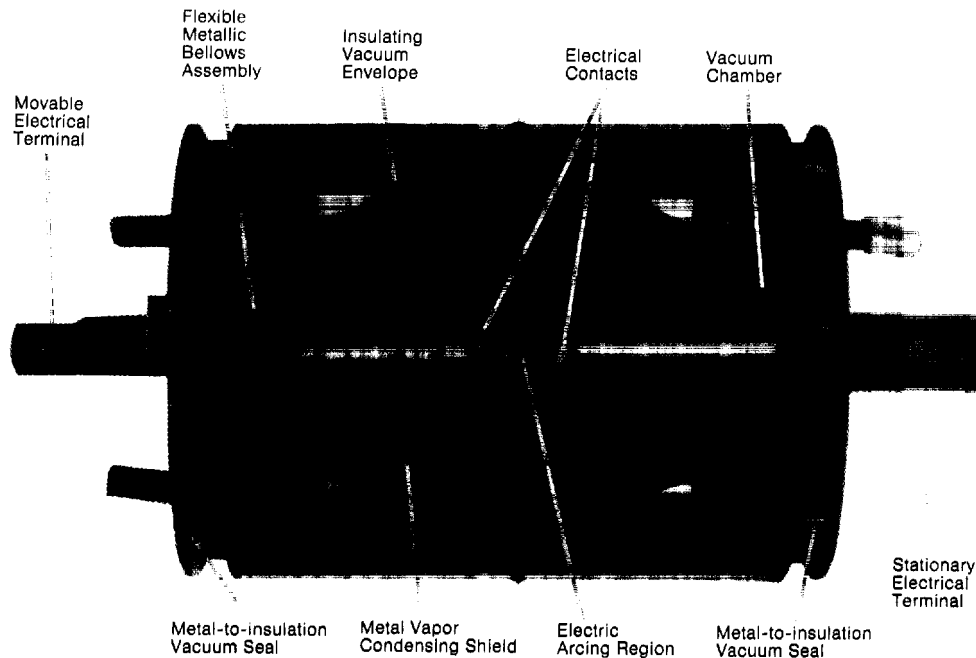
4. Contact Erosion Indicator. Vacuum interrupter contacts seldom wear out over the life-span of a circuit breaker in normal duty applications. Nevertheless, for inspection convenience a contact erosion indicator has been provided. It is visible with the breaker fully withdrawn and the front panel removed.

5. Interrupter Support. A rugged polyester glass molded piece supports each vacuum interrupter and its associated primary conductors. (Clear plastic housing is used for display purposes only.) This high tensile strength track-resistant polyester glass structure not only firmly positions and holds the interrupter and primary conductors, but also provides insulation to ground and between phases. For repair or replacement, this unique interrupter support assembly can be removed quickly and easily by removing only six bolts. When the support assembly is replaced, no readjustment of the vacuum interrupter contacts is needed and only a simple alignment of the primary conductors is required.



6. Breaker Mechanism. A simple, spring-charged stored-energy mechanism design eliminates the troublesome ratchet wheel and pawl required for spring charging in many conventional breaker mechanisms. The POWER/VAC breaker mechanism is mechanically and electrically trip-free and can be operated by dc control voltages of 48 V, 125 V or 250 V or ac voltages of 115 V or 230 V. Mechanism parts are high quality, close tolerance, 100 percent tool-made for operating consistency and reliability and ease of maintenance.

GE's POWER/VAC Interrupter:



Since 1961, more than 40,000 General Electric POWER/VAC vacuum interrupters have fulfilled the promise of this new power switching technology. GE's POWER/VAC interrupter transforms the sophisticated concept of vacuum switching into reality. The result—a simple, reliable device that provides fast, safe and quiet power switching. Proper utilization of the simple and efficient vacuum interrupter can reduce switchgear size and weight, lower maintenance requirements, and improve operating reliability compared to conventional switching technologies.

General Electric's new POWER/VAC metal-clad switchgear is optimized around the advantages attendant to vacuum switching.

Fast Interruption. The POWER/VAC interrupter is fast. Arc interruption typically takes place at the first current zero because the high dielectric strength of the vacuum gap results in an extremely short clearing time. Depending on interrupting rating, contact travel ranges from $\frac{1}{2}$ to $\frac{3}{4}$ inch for full interruption which permits a simple and reliable mechanism design.

Low Maintenance. Electrical contacts are sealed in a high vacuum environment equivalent to that existing in outer space. Vacuum is a nearly perfect medium for arc interruption—

fireproof, explosion-proof, and free of corona degradation. One set of contacts performs the functions of both main and arcing contacts and, since they are permanently sealed in a vacuum, away from dirt, moisture and pollutants, no contact maintenance is required. Only an occasional check of the contact erosion indicator is necessary. If desired, vacuum integrity may be checked by a one-minute hi-pot test of the vacuum interrupter.

Quiet, Safe Operation. GE's POWER/VAC interrupters do their job quietly in the new metalclad switchgear equipment. Arc extinction is silent and mechanism sound level is low. This feature makes POWER/VAC switchgear particularly suitable for application in shopping centers, hospitals and residential areas.

Long Service Life. GE POWER/VAC interrupters have been designed and tested to exceed 20 years shelf life and to exceed the performance requirements of applicable ANSI, IEEE and NEMA standards for metalclad switchgear.

POWER/VAC interrupters can give several times the service life of other types of interrupters. Under proper use, contact erosion is the only factor which limits vacuum interrupter life. In most normal duty applications, contact erosion will not exceed the allowable $\frac{1}{8}$ inch during the service life of the circuit breaker.

the key to increased reliability.

Operation of the GE POWER/VAC Interrupter.

The POWER/VAC interrupter is a simple device consisting of a pair of butt contacts, a vapor condensing shield and a bellows through which one of the contacts is moved . . . all sealed in a vacuum-tight enclosure.

The reason for its rapid arc interruption is the higher voltage withstand strength of the vacuum

environment surrounding the interrupter's contacts. Only a short contact travel is necessary to interrupt a power fault—generally $\frac{1}{2}$ to $\frac{3}{4}$ inch, depending on the interrupter rating. Therefore, total clearing is faster and simpler than that of other types of interrupting equipment. With the POWER/VAC interrupter, interrupting time is one cycle or less after contact parting—resulting in extended contact life and superior overall performance.

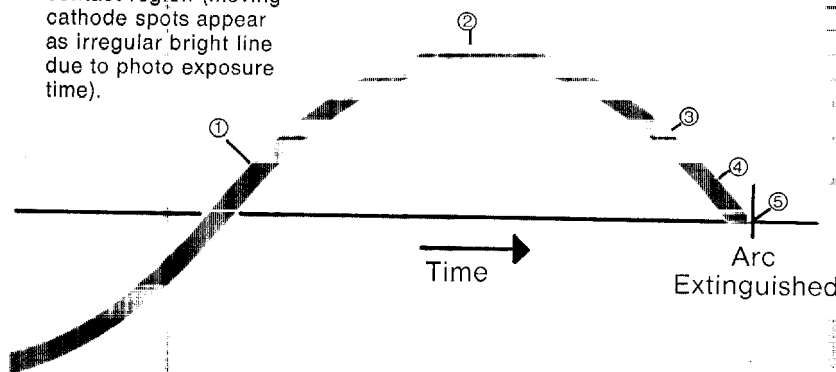
① Contacts have opened; with current at low value (see chart below), the arc is diffuse.

② At peak of the current wave, an intense arc encompasses entire contact region (moving cathode spots appear as irregular bright line due to photo exposure time).

③ As current decreases, intensity and energy of arc lessens.

④ Nearing current zero, only a faint glow of arc remains.

⑤ After current zero with recovery voltage applied; arc has been fully extinguished.



Interruption of arcing current occurs within one cycle after contact parting.

Pre-engineered device packages simplify equipment selection.

POWER/VAC switchgear is available with the same custom-designed device packages furnished today in conventional "one-high" switchgear units. So far, that's nothing unique . . . but there is a difference.

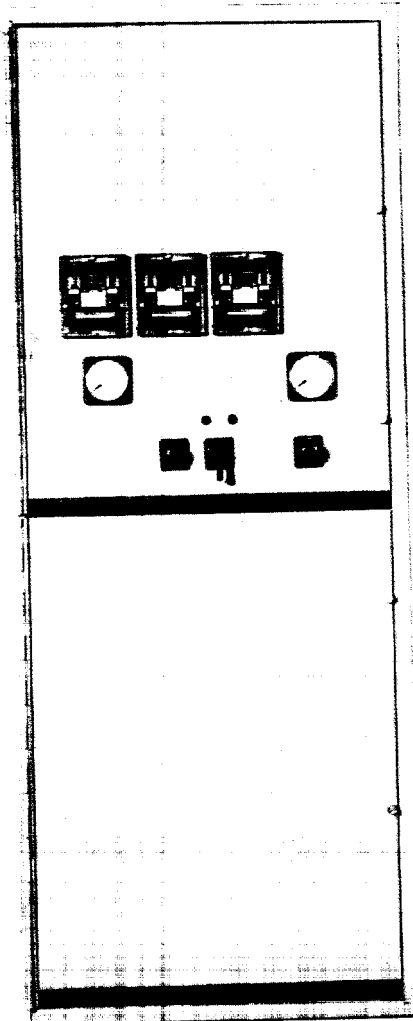
The PIC package

To complement its modern, highly-structured equipment and breaker designs, POWER/VAC switchgear features completely pre-engineered and standardized **P**rotection, **I**nstrumentation, and **C**ontrol (PIC) packages. Designed to meet the functional requirements of a wide variety of specific circuit breaker applications, these PIC packages contain all door-mounted devices such as relays, switches, meters, instruments and indicating lights required for each application and non-door-mounted devices such as fuses, current transformers and potential transformers, required for proper operation. This concept provides several benefits.

First, pre-designed packages can be ordered quickly and easily. You are assured of receiving exactly those devices in the material list, located exactly as shown on the door-panel drawing and wired exactly as indicated in the schematic diagram.

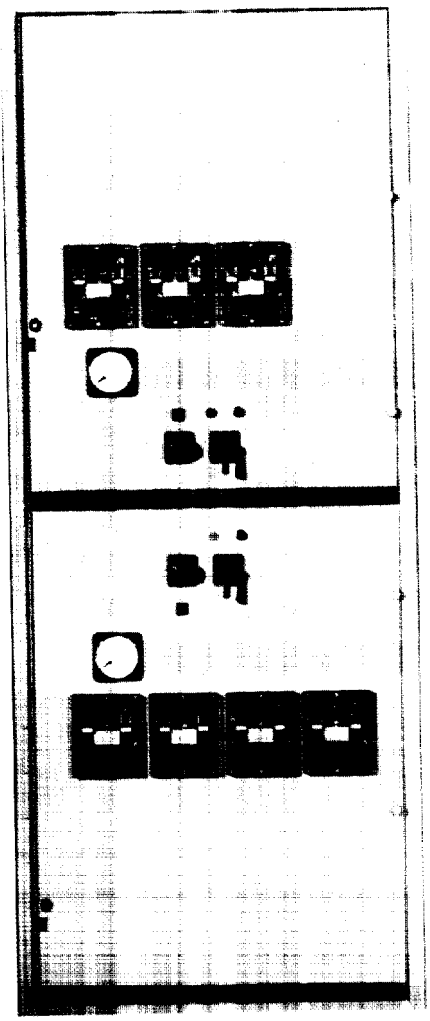
And, these standard PIC packages are fully documented and integrated with a special computerized drawing system. When you specify standard PIC device complements, you will receive these final drawings (front view, one-line diagram, device list and floor plan details) with your POWER/VAC switchgear proposal. No more guessing about the appearance of your switchgear or whether everything you wanted will be included. The equipment will be built as shown, resulting in fewer costly changes, fewer shortages and shipping errors and shorter delivery cycles.

The packages shown are illustrative of the many pre-engineered units available.

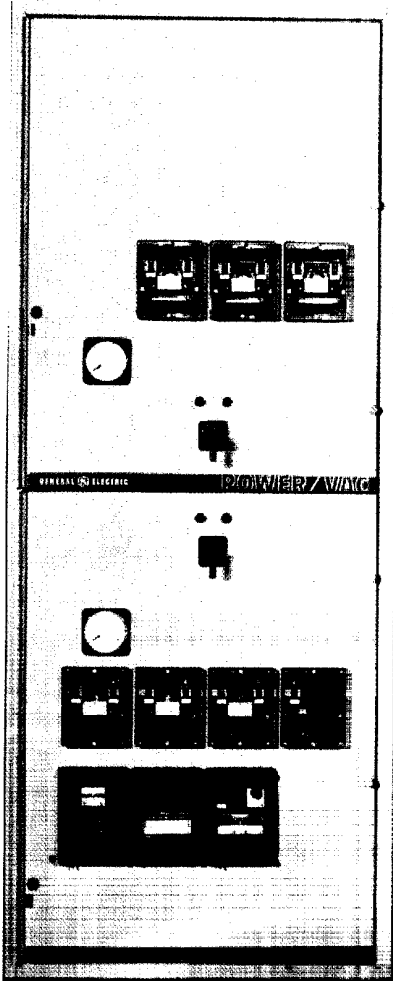


Incoming Line. This standard protection and control package is tailored for an incoming line with no transformer protection. Functions included are phase over-current protection, current indication, voltage indication and circuit breaker control with indicating lights. The breaker is located in the top unit and the fused potential transformer (PT) roll-out in the bottom unit.

Available as pre-engineered options are functions such as undervoltage and bus differential protection; watts and vars indication; and control features such as lockout and permissive switches.

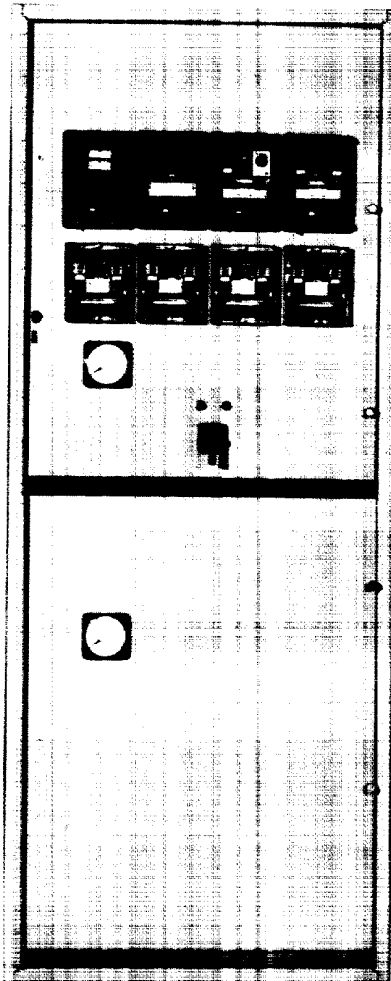


General Purpose Feeder. These two devices packages are almost identical, providing the basic functions of phase overcurrent protection, ampere indication and breaker control with indicating lights. The bottom unit also contains ground overcurrent protection (residual connected CT's). Both units house a circuit breaker in addition to the required complement of secondary devices. The flexibility of these basic feeder units is enhanced by standard options including automatic reclosing and bus differential CT's, volts and watt-hour demand indication, and voltage and current test blocks.

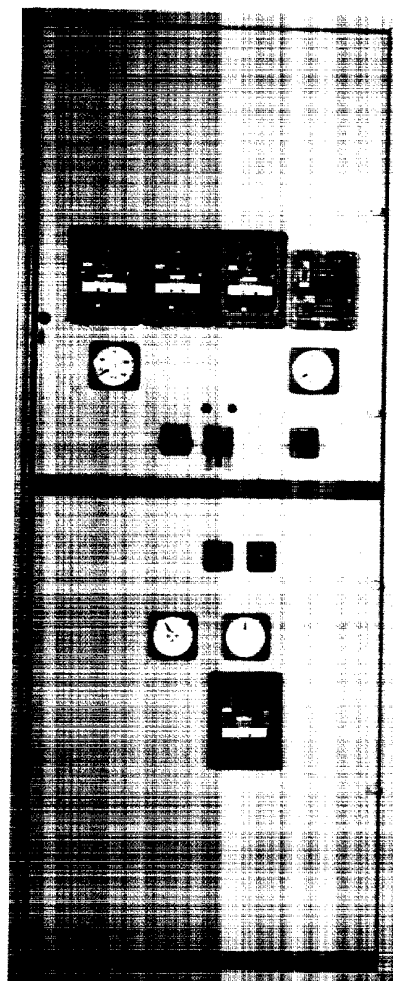


Induction Motor Full-Voltage Starting. The top unit includes local control for motors rated 1500 HP and below. Standard functions are phase and ground overcurrent and single-phase timed undervoltage protection, amperes indication and breaker control. Standard optional functions include bus differential current transformers; watts, watt-hour demand, and vars indication; and test blocks for current and voltage.

The bottom unit is also designed for induction motor full-voltage start, but for motors rated above 1500 HP. Two additional basic functions are included: machine differential and over-temperature protection.



Synchronous Motor Full-Voltage Starting. Recommended for machines above 1500 HP. It includes RTD's, machine self-balance differential and local control. Basic control, indication and protection functions are breaker control and field application control; amperes, field amperes and vars indication; and phase and ground over-current, incomplete sequence, self-balance differential and over-temperature protection. A variety of standard options are available. Among them: voltage unbalance protection, watt and watt-hour indication, and test blocks for volts and amps. The top unit houses the breaker; the bottom, the field application control devices.



Gas Turbine or Diesel Generator.

Typical of a more complex functional control and protection package. Basic functions include phase and ground over-current and reverse power protection; amperes, watts, vars and volts indication; and breaker control, ammeter, governor and synchronizing switches. Pre-engineered options include loss of excitation or loss of regulator potential protection; temperature, watt-hour and watt-hour demand indication; and current and voltage test blocks. As with the incoming line equipment, the breaker is located in the top unit and the PT roll-cut in the bottom.

Additional features and accessories

To facilitate inspection, maintenance and testing operations, General Electric offers a full selection of devices and accessories for POWER/VAC metalclad switchgear.

1. Ground and Test Devices. Ground and test devices provide facilities for grounding either the bus side or the outgoing cable side of the metalclad unit, or for "phasing out" the operating circuits.

The type GVV device is designed to make either the upper or lower primary conductors in the breaker unit readily accessible for grounding and testing. The device is racked between the connect and disconnect positions using the breaker racking mechanism. An optional remote racking control is available for added safety.

Terminals, accessible through the device front panel, are provided on each primary conductor to allow for testing and the attachment of grounding cables.

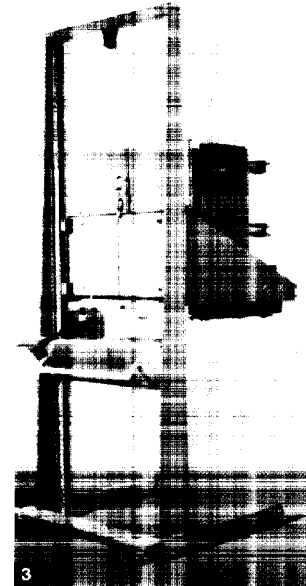
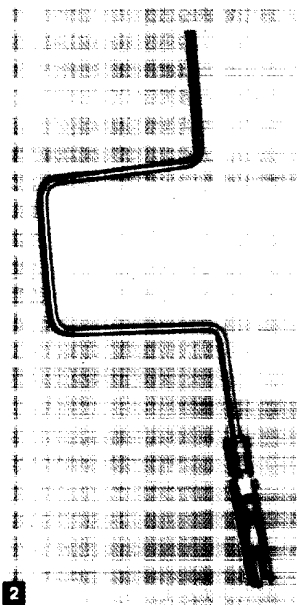
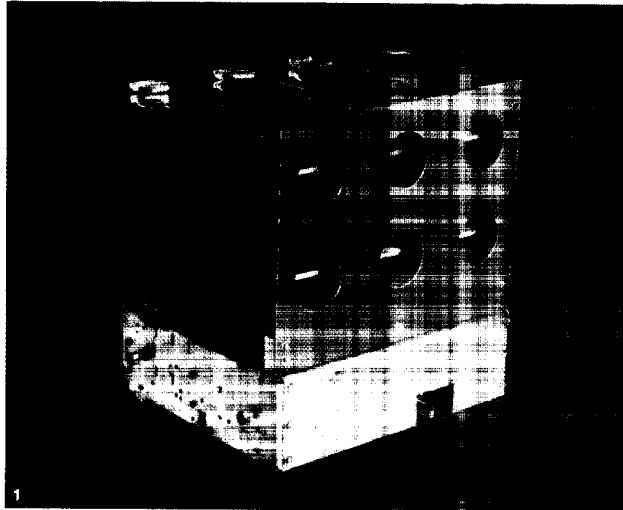
Since it includes no safety interlocks, application of the type GVV device is recommended only if operated under the supervision of experienced operating engineers.

The deluxe power-operated type GMV device has a self-contained bus or line selector switch and a separately controlled, power operated, three-phase grounding switch. The GMV device is a dead-front design with mechanical and electrical interlocks, provision for remote control and plug-type cable testing and phasing. The primary conductors required for grounding are self-contained, with no external cable connections required.

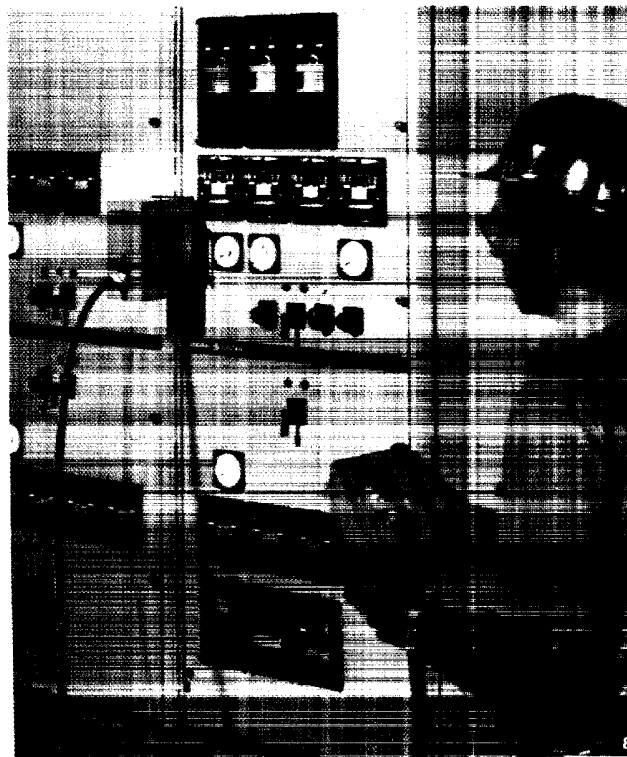
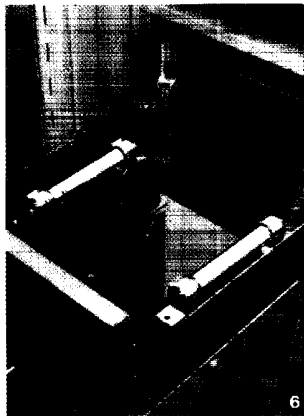
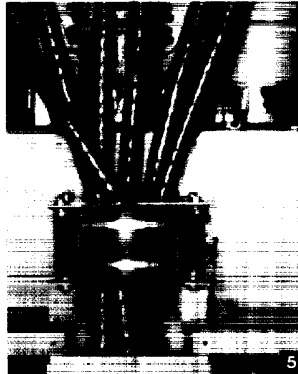
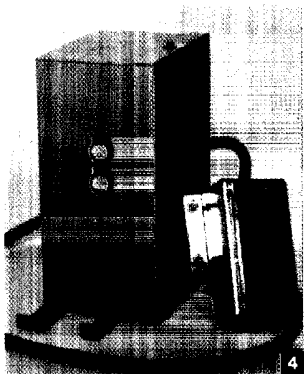
The GMV device is designed for maximum safety to personnel while accomplishing all the basic required grounding and testing functions.

2. Racking Handle operates the breaker racking mechanism to manually move the breaker between the connected and disconnected positions.

3. Portable Breaker Lift is designed for easy removal of the breaker from its compartment and transport to a maintenance area. It is designed for use on indoor and outdoor equipment.



increase flexibility of operation.



4. Test Cabinet provides for electrical closing and tripping of breakers at indoor maintenance locations.

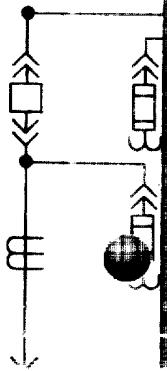
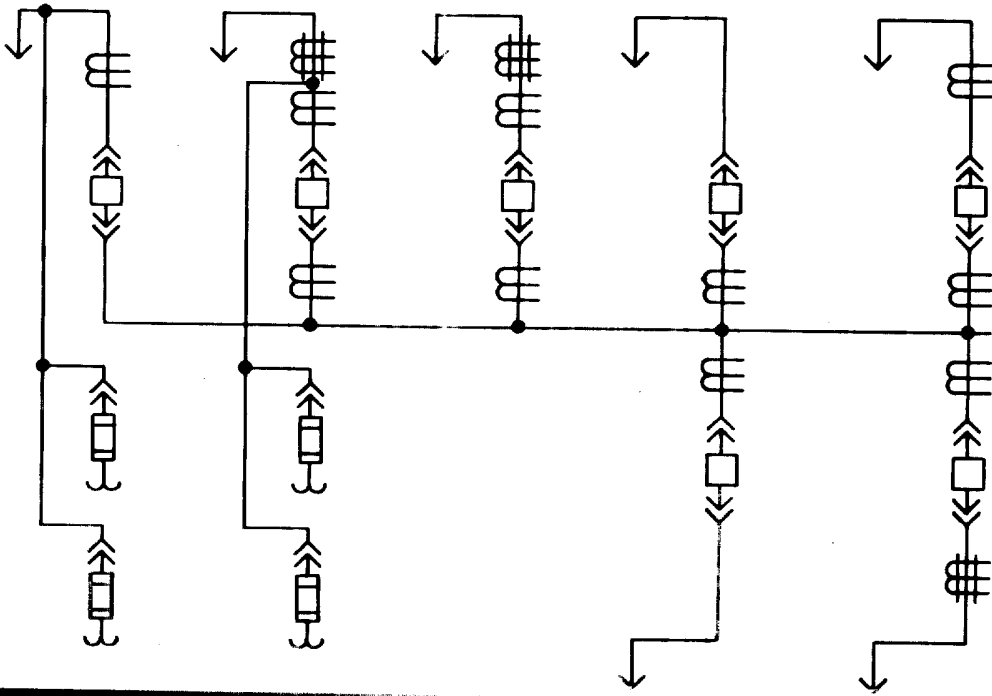
5. Ground-sensor Equipment. A carefully matched current transformer and high speed relay comprise a "ground-sensor" equipment. It has the sensitivity required to rapidly open the breaker and greatly reduce damage caused to motors by low current faults.

6. Easy Access Transformers. Molded epoxy resin insulation assures full basic insulation level for GE dry type control power transformers. Current limiting type EJ fuses are provided for control power circuit protection. Transformer is draw-out mounted for accessibility in ratings through 15 kVA single phase.

7. Hy-Bute/60 Potential Transformer. Hy-Bute 60 GE potential transformers are as much as 40 percent smaller than compound-filled potential transformers of the same rating. This smaller size can reduce the space required for accessory equipment in metal-clad by as much as a full compartment. Characteristics meet all applicable industry standards.

8. Added Safety With Remote Control. When maximum safety for operating personnel is desired while racking a breaker between the connected and disconnected positions, a remote control electrically operated racking attachment can be used. It is easily mounted to the breaker unit front door and allows remote connection and disconnection of the breaker up to fifty feet away from the unit. When used with the remote close and trip option, totally remote operation is provided.

Meet power system requirements in less floor space.



General Electric POWER/VAC switchgear is compact. Unique two-tier construction can provide switchgear floor space savings of up to 50 percent for 13.8 kV equipment and up to 20 percent for 4.16 kV equipment. The exact amount of floor space reduction for your installation will depend on breaker rating, the number and type of panel and auxiliary devices, and the power circuit configuration.

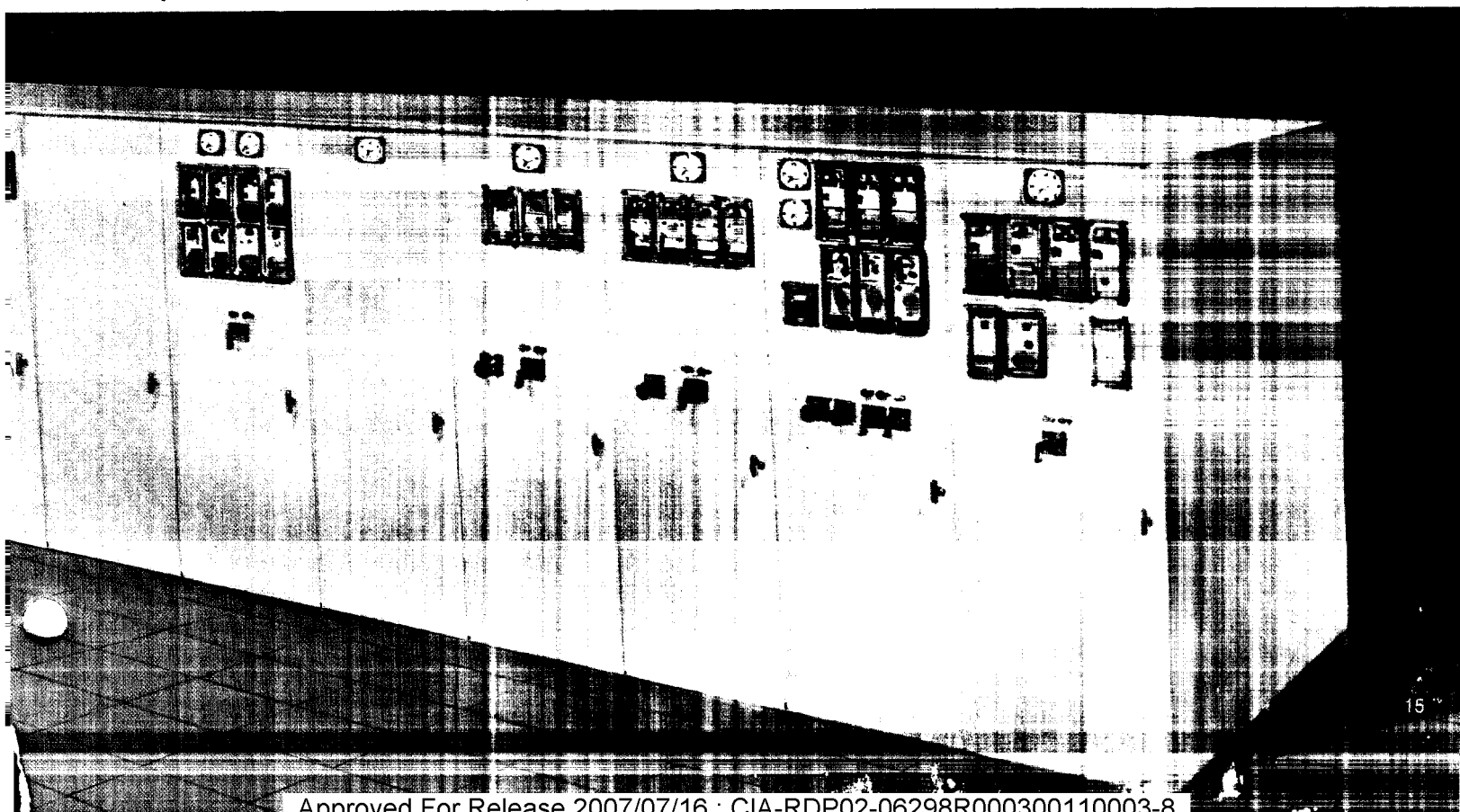
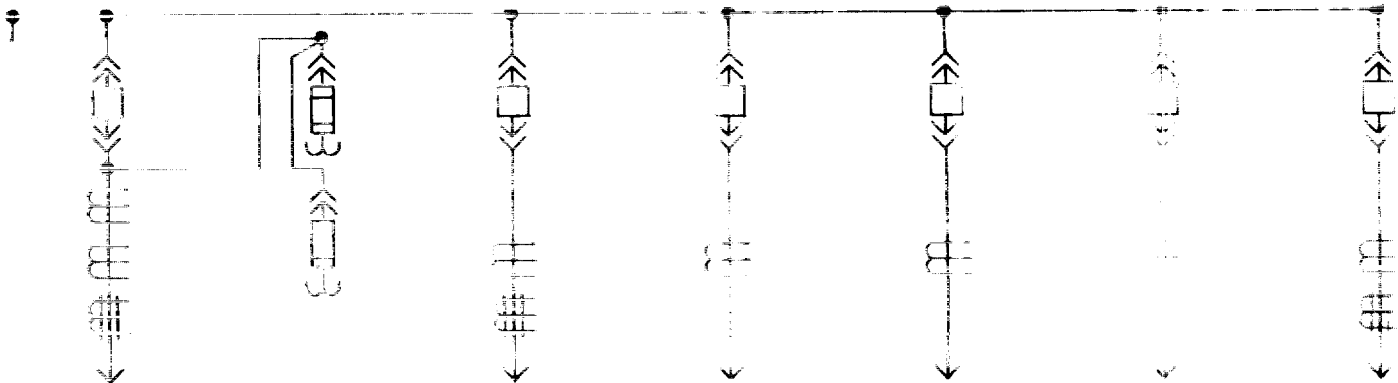
To illustrate floor space savings, a size comparison between 13.8 kV POWER/VAC switchgear and conventional air-magnetic switchgear is shown below. The one-line diagram shows the functional units included in each lineup. A variety of typical unit types was chosen to show the application flexibility of POWER/VAC switchgear. Ten air-magnetic switchgear units are needed to house the breakers and devices shown, requiring a floor area

360 inches long and 80 inches wide, or 200 square feet. These same breaker and device functions can be accommodated in five POWER/VAC switchgear units, requiring a floor area 180 inches long and 82 inches wide—only 102 square feet.

Savings . . . 98 square feet or 49 percent.

The five-unit POWER/VAC lineup shown can also be shipped complete, without shipping splits. No unit assembly, main bus joint makeup or inter-unit control wiring connections are required. In contrast, the air-magnetic lineup must be shipped in at least two sections, resulting in on-site assembly and inter-unit connection work.

Thus, POWER/VAC switchgear gives you savings in two more ways—in valuable floor space and in costly on-site assembly work.



Reliability is assured through rigid quality assurance standards.

POWER/VAC switchgear quality begins with basic materials—like steel, aluminum, epoxy, porcelain and track-resistant polyester glass—and GE uses only the best. All raw materials and purchased components are given a thorough inspection when received, to assure compliance with exacting specifications. But, material testing doesn't end there. Important insulation materials, such as track resistant polyester glass receive numerous production and laboratory tests. Laboratory tests on selected samples include insulation tracking tests, power factor, impact strength, Rockwell hardness, and elasticity and tensile strength.

Manufacture of parts is highly tooled and assembly and test operations are automated where possible. For example, the breaker mechanism is made from all tool-made parts for uniformity, precision assembly and reliable operation. Numerically-controlled machines with high quality tooling are used extensively, providing consistently accurate fabricated parts which reduce assembly and alignment problems during both initial manufacture and field repair or replacement.

GE's production area for POWER/VAC vacuum interrupters is one of the most technologically sophisticated facilities in the world for making arc interruption devices. Components are cleaned to remove microscopic impurities, stored in nitrogen-filled containers and baked at high temperature in a vacuum to remove any gasses. Parts are welded in an atmosphere of inert argon, and, after vacuum pumping and sealing, the finished interrupter is leak tested using an ultra-sensitive, patented testing process developed by General Electric. This care in manufacture has made the POWER/VAC vacuum interrupter the industry leader in quality and service reliability.

Breakers and equipment are given complete production tests prior to shipment. These include power frequency dielectric tests (hi-pot), mechanical operation tests, and electrical operation and control wiring checks. All breakers are given at least 100 no-load operations to insure proper adjustment, alignment and functioning.

Finally, POWER/VAC switchgear equipment and breakers are carefully packed and crated to insure arrival at your site in first class condition.

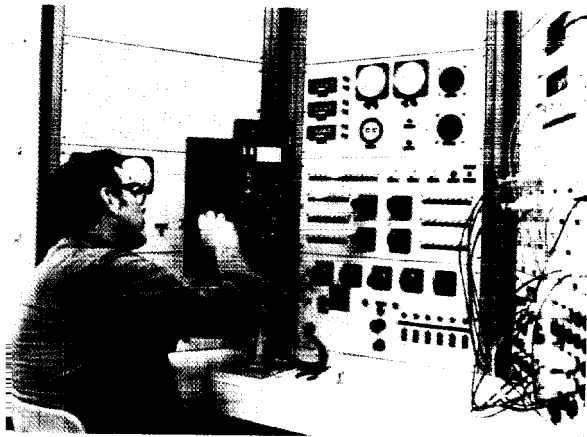
To assure continued production of the industry's standard of excellence in metalclad switchgear, General Electric conducts a continuing and thorough testing program. Some of the quality checks made on GE's POWER/VAC switchgear are:

POWER/VAC Vacuum Circuit Breakers

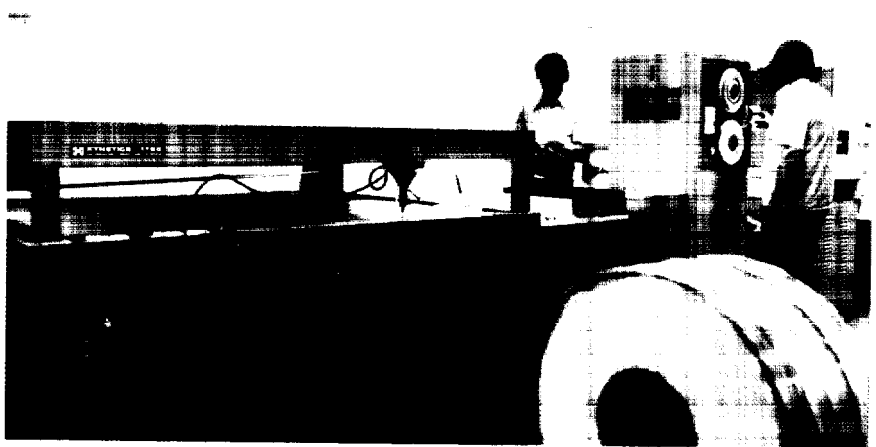
- mating and matching points checked and adjusted by precise master fixture alignment to assure unit interchangeability.
- auxiliary wiring tested for continuity and correctness.
- mechanism operated at maximum, minimum and rated voltages to assure smooth operation.
- resistance of operating coils measured.
- resistance of each pole measured by low ohmic bridge.
- high potential test
- final inspection

Breaker Housings

- compartment frame multiple point alignment checked against master fixture.
- final master breaker fixture alignment of all mating and matching points is made including primary bushing and conductor matching, auxiliary contact mating, grounding shoe contact, plus checks to insure interchangeability of breakers.
- auxiliary wiring checked to assure correctness and continuity.
- all relays and other devices are given complete secondary power check using test consoles.
- high potential tests made of primary and secondary circuits in accordance with ANSI standards.
- final inspection



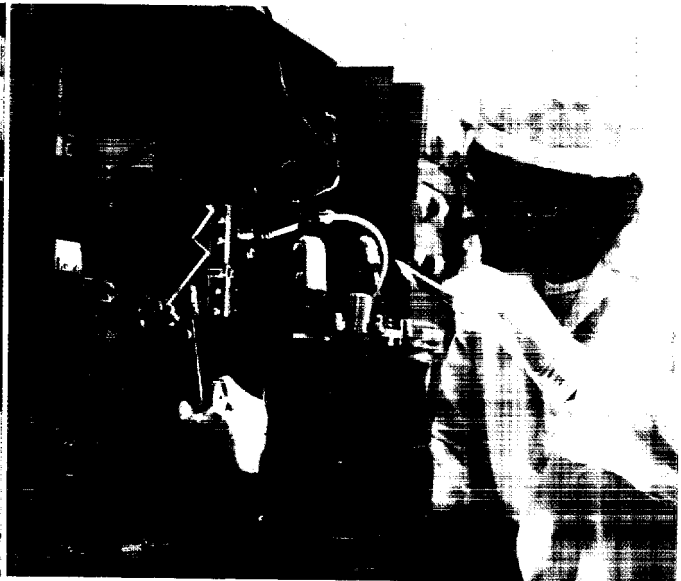
Operating and timing tests prior to shipment help assure the integrity of protective relays.



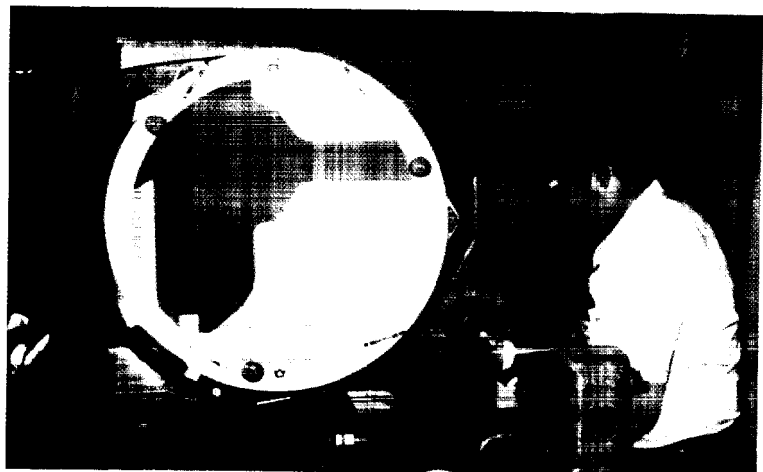
Computerized equipment drawings assure accurate, legible prints, avoiding costly errors.



Ultra-clean facilities and sophisticated equipment are evident throughout the complete production cycle of vacuum interrupters. Finished units are leak tested to assure 20 year shelf life.



Numerically controlled machines meet the increasingly stringent requirements of GE switchgear design engineering.



Optical comparator gives precise evaluation of critical part contours and characteristics.

Breakers are thoroughly tested to standards... designed for easy inspection and maintenance.

General Electric's new POWER/VAC metalclad switchgear was thoroughly tested to all applicable ANSI, IEEE and NEMA standards. Typical tests included fault current interruption, dielectric withstand, continuous current carrying, load current switching, capacitance current switching and mechanical life tests.

In addition, selected electrical tests were run in a wide range of environments which simulated field conditions. For example, mechanical operations were run following cold soak at -25°C and hot soak at $+40^{\circ}\text{C}$. Electrical tests were run after high humidity soak and extreme temperature cycling between 57°C and -25°C . Specific dielectric tests were run following exposure to dust and representative industrial pollutants to check for insulation degradation.

This test program was carefully designed to meet pre-set operating and reliability goals based on switchgear failure rate data in the IEEE *Report on Reliability Survey of Industrial Plants*.^{*} Sample sizes, type tests, number of tests and required results were coordinated to provide the most thoroughly tested medium voltage drawout circuit breaker that General Electric has ever produced.

Typical of the extensive testing conducted on POWER/VAC switchgear are dielectric tests. These design tests were run to determine adequacy of the POWER/VAC design to meet its assigned ratings and to insure long insulation life under normal operating service conditions.



Dielectric tests required by industrial standards are rated low frequency withstand voltage (hi-pot) tests, and rated full wave impulse withstand voltage (impulse) tests. Test voltage and success criteria for these tests are summarized in Table I. In addition, corona tests were conducted to confirm corona extinction above minimum allowable voltage (15 percent greater than maximum line-to-ground voltage). Corona testing is important because it can detect insulation or conductor design deficiencies which could cause accelerated insulation degradation, leading to insulation failure after several years of operation.

^{*} Presented May 13-16, 1973 at the IEEE Industrial and Commercial Power Systems Technical Conference.

TABLE I Dielectric Test Requirements for POWER/VAC Metalclad Switchgear

Circuit Breaker Rated Maximum Voltage (kV)	Insulation		Corona Tests [*]
	Rated Withstand Test Voltage		Minimum allowable corona extinction rms voltage (Line-to-ground) (kV)
	Low Frequency, rms, hi-pot test (kV)	Crest Impulse (kV)	
4.76 8.25 15.00	19 36 36	60 95 95	3.2 5.5 10.0
Success Criteria	No flashover or insulation puncture.	No flashover or insulation puncture.	Corona extinction occurs above allowable voltage.
[*] Corona tests are not required by industry standards.			

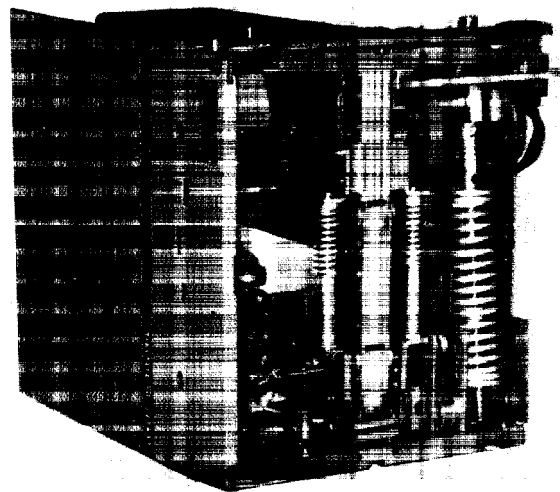
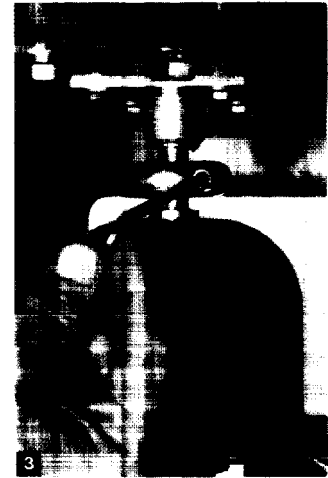
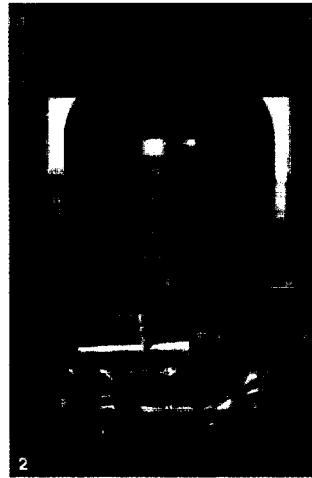
1. Routine Inspection. The POWER/VAC vacuum breaker is designed for reliable, consistent operation and low maintenance. Central to this theme is efficient utilization of the design advantages offered by vacuum interrupters—simplicity, small size and high reliability. With the POWER/VAC breaker there are no arc chutes, no blowout coils, no arc runners, no puffer tube, no arcing by-products, and no contact maintenance. Routine inspection and maintenance is reduced to visual inspection for damage, removing dirt, lubricating and checking linkage adjustment, and checking the contact erosion indicator for contact wear. A more extensive maintenance check can include hi-potting the interrupters to confirm vacuum integrity.

2. Inspection for contact wear . . . can be done with the breaker in the withdrawn position. Remove the breaker front panel and the contact wear indicators are visible. A full $\frac{1}{8}$ inch wear is allowed before vacuum interrupter replacement is recommended.

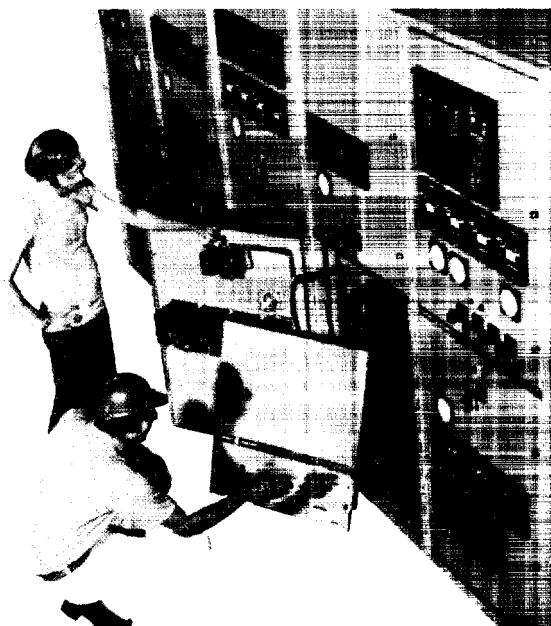
3. Contact linkage adjustment . . . is infrequent, but if required, can be done without disassembling the breaker. Just remove the breaker front cover and the contact linkage can be adjusted through the front cutout in the vacuum interrupter support assembly.

4. Mechanism inspection . . . is easy and fast. A complete inspection, including lubrication and adjustment, can be made with the breaker tilted on its side.

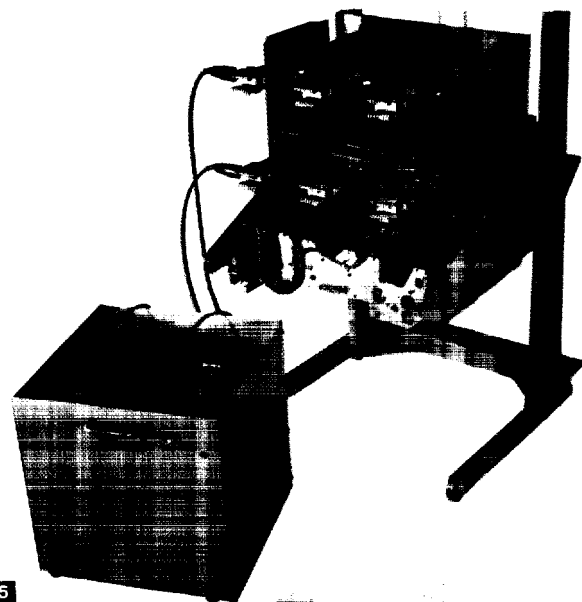
5. Vacuum integrity . . . can be confirmed by conducting a one-minute hi-pot test on each vacuum interrupter. Test voltage is applied to the breaker primary conductors with the interrupter contacts in the open position.



4



1



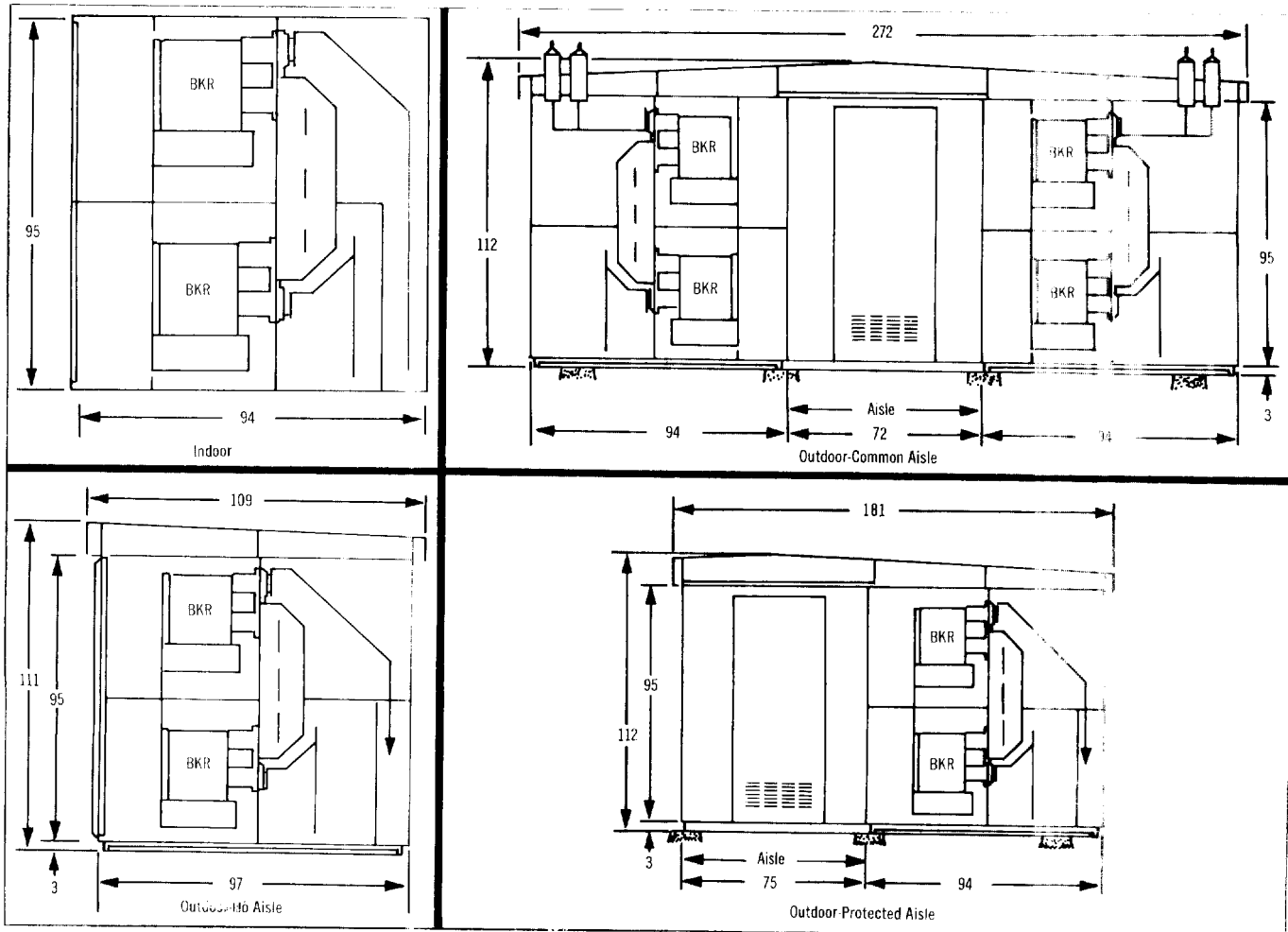
5

Ratings, weights and dimensions.

Weights and Dimensions—Breakers and Equipment (All dimensions in inches. Weights in pounds.)

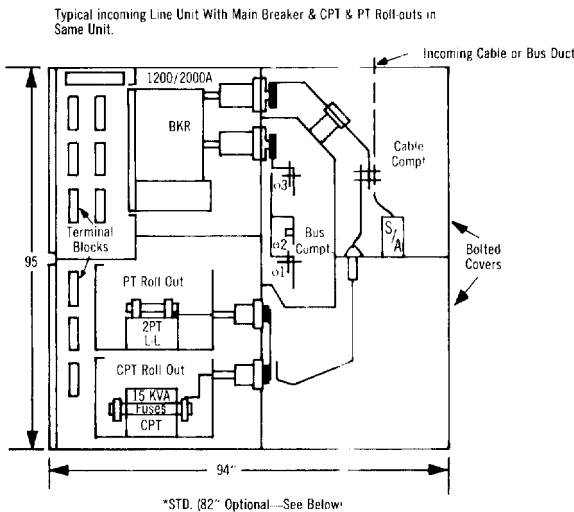
Breaker Type	Current Rating (Amperes)	Breaker Weights	Indoor						Outdoor*								Indoor and Outdoor		
			Height	Depth	Breaker Vertical Section (Less Breakers)		Auxiliary Vertical Section		Height	Depth	Breaker Vertical Section (Less Breakers)		Auxiliary Vertical Section		Add For Protected Aisle To Each Vertical Section		Rollout Weight (PT-CPT)	Required Clearance	
					Width	Weight	Width	Weight			Width	Weight	Width	Weight	Depth	Weight		Front Aisle Min.	Rear Aisle Min.
VB-4.16-250	1200	550	95	94	36	2600	36	2600	112	109	36	3100	36	3100	72	1100	500	54	26
	2000	650																	
VB-4.16-350	1200	550																	
	2000	650																	
	3000	780																	
VB-7.2-500	1200	550																	
	2000	650																	
VB-13.8-500	1200	550																	
	2000	650																	
VB-13.8-750	1200	550																	
	2000	650																	
VB-13.8-1000	1200	550																	
	2000	650																	
	3000	780																	

Typical Section Dimensions—Indoor and Outdoor Equipment (All dimensions in inches.)



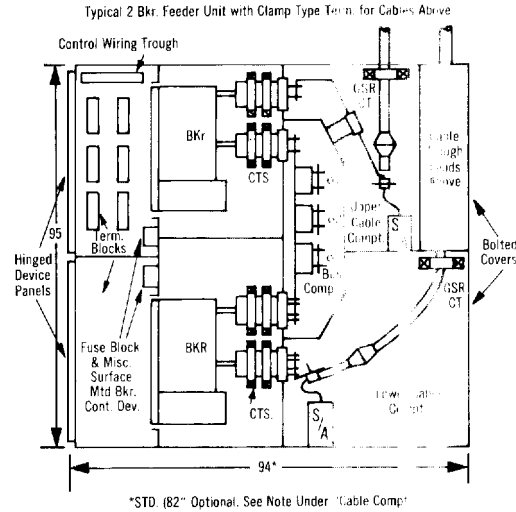
*For common aisle construction, add 1500 pounds to weight of 12' indoor vertical sections.

Typical Equipment Section Views



CABLE COMPARTMENT

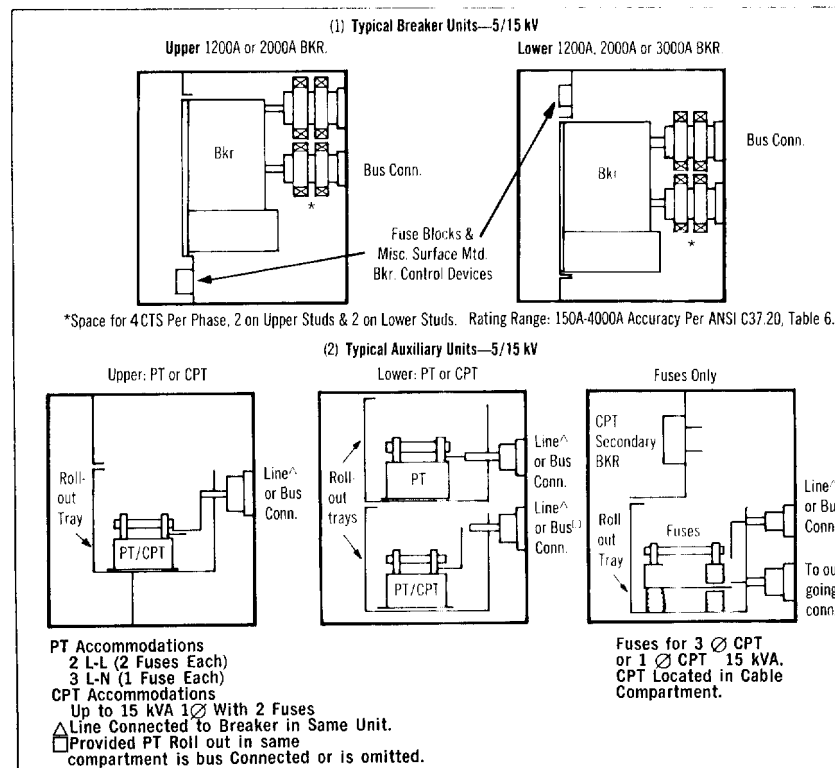
- * Certain simple cable compartment configurations such as clamp type terminations for one moderate-sized cable per phase, with or without Ground Sensor, permit a unit depth of 82 inches on indoor units.
- Designed for up to 2-750 MCM/Ø per breaker; cables above or below.
- CT's with greater than ANSI accuracy must be mounted in cable compartment and may limit such cases to one breaker per vertical section.
- Stress cone space of 20 inches is provided and use of preformed stress cones, such as GE Termimatic (TM), is recommended.



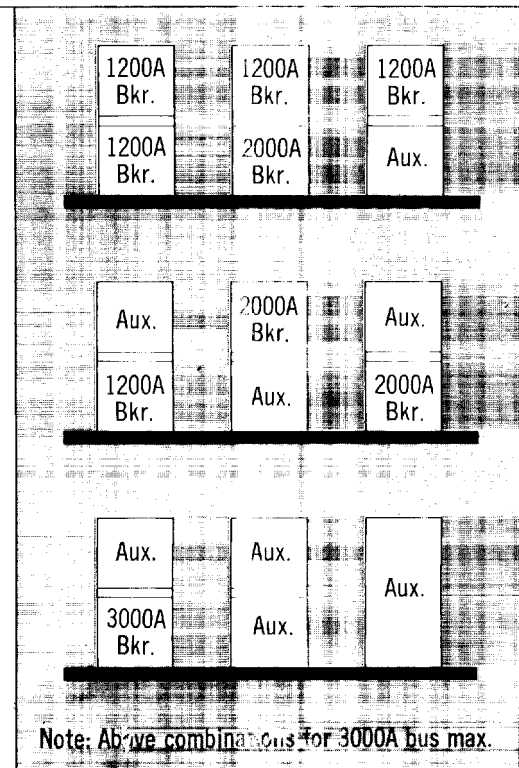
BUS COMPARTMENT

- 1200A and 2000A: Aluminum standard; copper optional.
- 3000A bus is copper only.
- Bus supports designed for 80,000A momentary.
- All joints connected with 2 bolts and booted.
- Bus support insulation system:
 - Non-tracking polyester glass (std. 5 kV)
 - Porcelain inserts (std. 15 kV)
 - Fluidized bed epoxy bus insulation

Typical Upper and Lower Unit Configurations



Available Unit Combinations

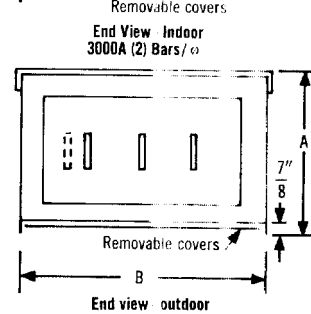
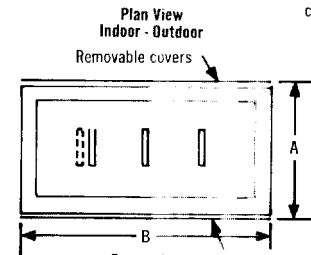
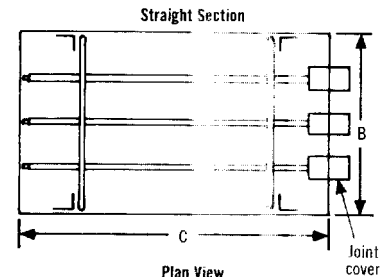
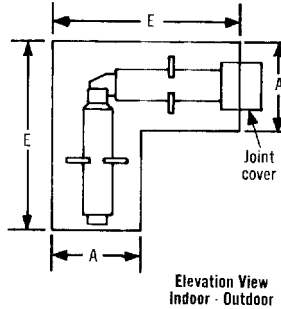
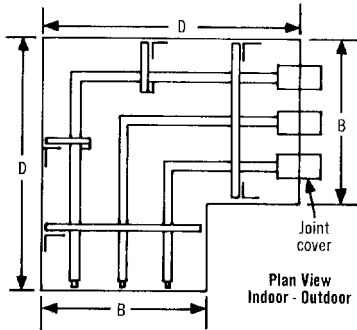


Ratings, weights and dimensions.

Metal-Enclosed Nonsegregated Phase Bus

Installation	Voltage Rating (kV)	Continuous Current Rating (Amperes)	Dimensions—Inches					Net Weight Pounds per Foot *	
			A	B	C	D	E	AL	CU
Indoor	4.16 or 13.8	1200	16	26	Max of 96	34	26	50	55
		2000	16	26		34	26	55	70
		3000	16	36		44	26	70	105
Outdoor	4.16 or 13.8	1200	16¾	26		34	26	60	65
		2000	16¾	26		34	26	65	75
		3000	16¾	36		44	26	75	110

* Measured on center line.



Note: All dimensions and weights are approximate. Do not use for construction.

POWER/VAC Metalclad Switchgear is designed, tested and built to these applicable industry standards

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) 70 East 45th Street New York, New York 10017		NATIONAL ELECTRICAL MANUFACTURERS ASS'N (NEMA) 155 East 44th Street New York, New York 10017	
Standard No.	Description	Standard No.	Description
C37.04	AC Power Circuit Breaker Rating Structure	SG-2	High-voltage Fuses
C37.06	Preferred Ratings of Power Circuit Breakers		
C37.07	Interrupting Factors — Reclosing Service	SG-4	Power Circuit Breakers
C37.09	Test Procedure for Power Circuit Breakers		
C37.010	Application Guide for Power Circuit Breakers	SG-5	Power Switchgear Assemblies
C37.11	Power Circuit Breaker Control Requirements		
C37.20	Switchgear Assemblies and Metal-Enclosed Bus		
C37.100	Definitions for Power Switchgear	SG-6	Power Switching Equipment

POWER/VAC Power Circuit Breaker Characteristics (Symmetrical Rating Basis ANSI C37.06)

Identification			Rated Values								Related Required Capabilities				
ANSI Line Number	Nominal rms Voltage Class (kV)	Nominal 3-phase Class (MVA)	Voltage		Insulation Level		Current		Rated Inter- rupting Time (Cycles)	Rated Per- missible Tripping Delay, Y (Seconds)	Rated Maximum rms Voltage Divided by K (kV)	Current Values			
			Rated Maximum rms Voltage (kV) (1)*	Rated Voltage Range Factor, K (2)	Rated Withstand Test Voltage		Con- tinuous rms Current Rating at 60 Hz (amperes)	Short- circuit rms Current Rating (at Rated Max kV) (kA) (3) (4)				Maximum Symmet- rical Inter- rupting Capability (5)	3 Sec Short- time Current Carrying Capability	Closing and Latching Capability 1.6 K Times Rated Short- circuit rms Current (kA)	
K Times Rated Short-circuit rms Current		(kA)	(kA)												
3	4.16	250	4.76	1.24	19	60	1200	29	5	2	3.85	36	36	58	
4	4.16	250	4.76	1.24	19	60	2000	29	5	2	3.85	36	36	58	
5	4.16	350	4.76	1.19	19	60	1200	41	5	2	4.0	49	49	78	
5a	4.16	350	4.76	1.19	19	60	2000	41	5	2	4.0	49	49	78	
6	4.16	350	4.76	1.19	19	60	3000	41	5	2	4.0	49	49	78	
8	7.2	500	8.25	1.25	36	95	1200	33	5	2	6.6	41	41	66	
9	7.2	500	8.25	1.25	36	95	2000	33	5	2	6.6	41	41	66	
11	13.8	500	15	1.30	36	95	1200	18	5	2	11.5	23	23	37	
12	13.8	500	15	1.30	36	95	2000	18	5	2	11.5	23	23	37	
13	13.8	750	15	1.30	36	95	1200	28	5	2	11.5	36	36	58	
14	13.8	750	15	1.30	36	95	2000	28	5	2	11.5	36	36	58	
15	13.8	1000	15	1.30	36	95	1200	37	5	2	11.5	48	48	77	
15a	13.8	1000	15	1.30	36	95	2000	37	5	2	11.5	48	48	77	
16	13.8	1000	15	1.30	36	95	3000	37	5	2	11.5	48	48	77	

Non-standard Breakers—High Close and Latch Capability

	4.16	250	4.76	1.24	19	60	1200 2000	29	5	2	3.85	36	36	78
	13.8	500	15	1.30	36	95	1200 2000	18	5	2	11.5	23	23	58
	13.8	750	15	1.30	36	95	1200 2000	28	5	2	11.5	36	36	77

*Numbers in parentheses refer to the Notes, below.

- Maximum voltage for which the breaker is designed and the upper limit for operation.
- K is the ratio of rated maximum voltage to the lower limit of the range of operating voltage in which the required symmetrical and asymmetrical interrupting capabilities vary in inverse proportion to the operating voltage.
- To obtain the required symmetrical interrupting capability of a circuit breaker at an operating voltage between 1/K times rated maximum voltage and rated maximum voltage, the following formula shall be used:

$$\text{Required Symmetrical Interrupting Capability} = \frac{\text{Rated Short-circuit Current} \times (\text{Rated Max. Voltage})}{(\text{Operating Voltage})}$$

For operating voltages below 1/K times rated maximum voltage, the required symmetrical interrupting capability of the circuit breaker shall be equal to K times rated short-circuit current.

- With the limitation stated in 04-4.1 of ANSI C37.04, all values apply for polyphase and line-to-line faults. For single phase-to-ground faults, the specific conditions stated in 04-4.5.1.3 of ANSI C37.04 apply.

- Current values in this column are not to be exceeded even for operating voltages below 1/K times rated maximum voltage. For voltages between rated maximum voltage and 1/K times rated maximum voltage, follow (3) above.

ANSI-C37.06 symmetrical rating basis is supplementary to ANSI-C37.6 (total current rating basis) and does not replace it. When a changeover from the total current basis of rating to the symmetrical basis of rating is effected the older standards will be withdrawn.

In accordance with ANSI C37.06 users should confer with the manufacturer on the status of the various circuit breaker ratings.



Switchgear Business Department • 6901 Elmwood Avenue • Philadelphia, PA 19142

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